MonPE20

Development of the Pepper-pot Emittance Meter for Diagnostics of Low-Energy Multi-Charged Heavy Ion Beams Extracted from an ECR Ion Source

Takashi Nagatomo[1], Vasilis Tzoganis[1,2,3], Masayuki Kase[1], Osamu Kamigaito[1], and Takahide Nakagawa[1]

[1]*RIKEN Nishina Center, Wako, Japan*
[2] *Cockcroft Institute, Warrington, United Kingdom,*

[3]*University of Liverpool, Liverpool, United Kingdom*

Corresponding Author: Takashi Nagatomo, e-mail address: nagatomo@riken.jp

To improve the beam transport in LEBT, it is important to understand the dynamics of ion beams extracted from an ECR ion source. Transverse emittances are crucial parameters for beam quality, and the beam intensity can be optimized by means of emittance matching with the LEBT's acceptance. Moreover, the importance of decoupling any inter-plane correlation in the transverse 4D emittance is discussed as it can lead to increasing the beam brightness [1]. Within this scope, we have developed an emittance meter based on the pepper-pot method that can measure the 4D phase-space distribution. For simplicity, the ion beam passing through the pepper-pot pin-holes directly impinges on a transparent scintillator and the light is collected from the backside by means of a CMOS camera. The scintillator is a critical part of the device and investigations on scintillators with several MeV/u ion beams were performed [2]. However, because of lower energy and higher intensity of the beam extracted from the ECR source, degradation of the scintillator induced by irradiation is a concern. At first, scintillators including CsI, KBr, CaF_2 and quartz have been investigated with proton beam (~100 eμA, 6.52 keV). Quartz was found to be the most resilient to damage featuring also linear light emission proportional to beam intensity, but light output was lower than the others. On the other hand, light emissions from CsI, KBr and CaF_2 was initially higher but degraded quickly. A commercial CMOS camera has been customized for water-cooled operation that results in significant thermal noise reduction under high gain/long exposure time operation. Software based on Labview takes care of the data acquisition and real time emittance calculation. Typical processing time from image capture to 4D phase space plots is around 1 s.

References

[1] C. Xiao et.al., Phys. Rev. STAB, **16**, 044201 (2013), L. Groening, Phys. Rev. STAB, **14**, 064201 (2011).
[2] Eiko Gütlich et.al, IEEE Trans. Nucl. Sci., **57**, 1414 (2010).